The Magazine for ENERGY EFFICIENCY in Compressed Air, Pneumatics, Blower and Vacuum Systems

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October 2015

Metal Fabrication & Machining


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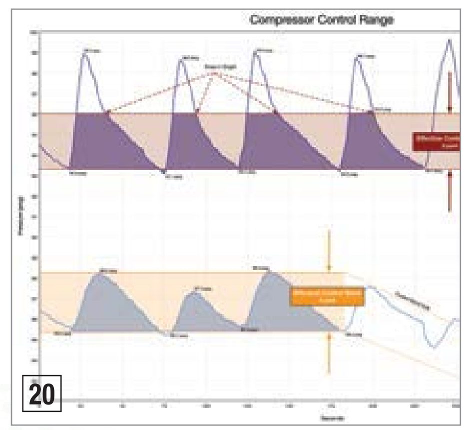

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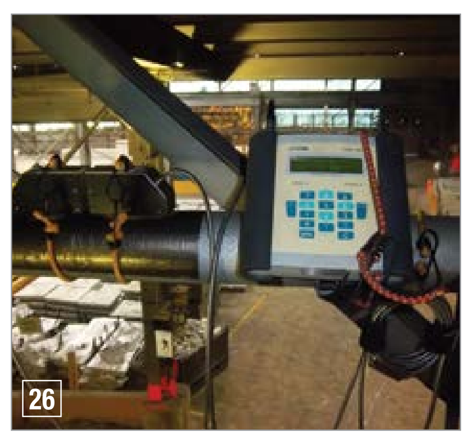
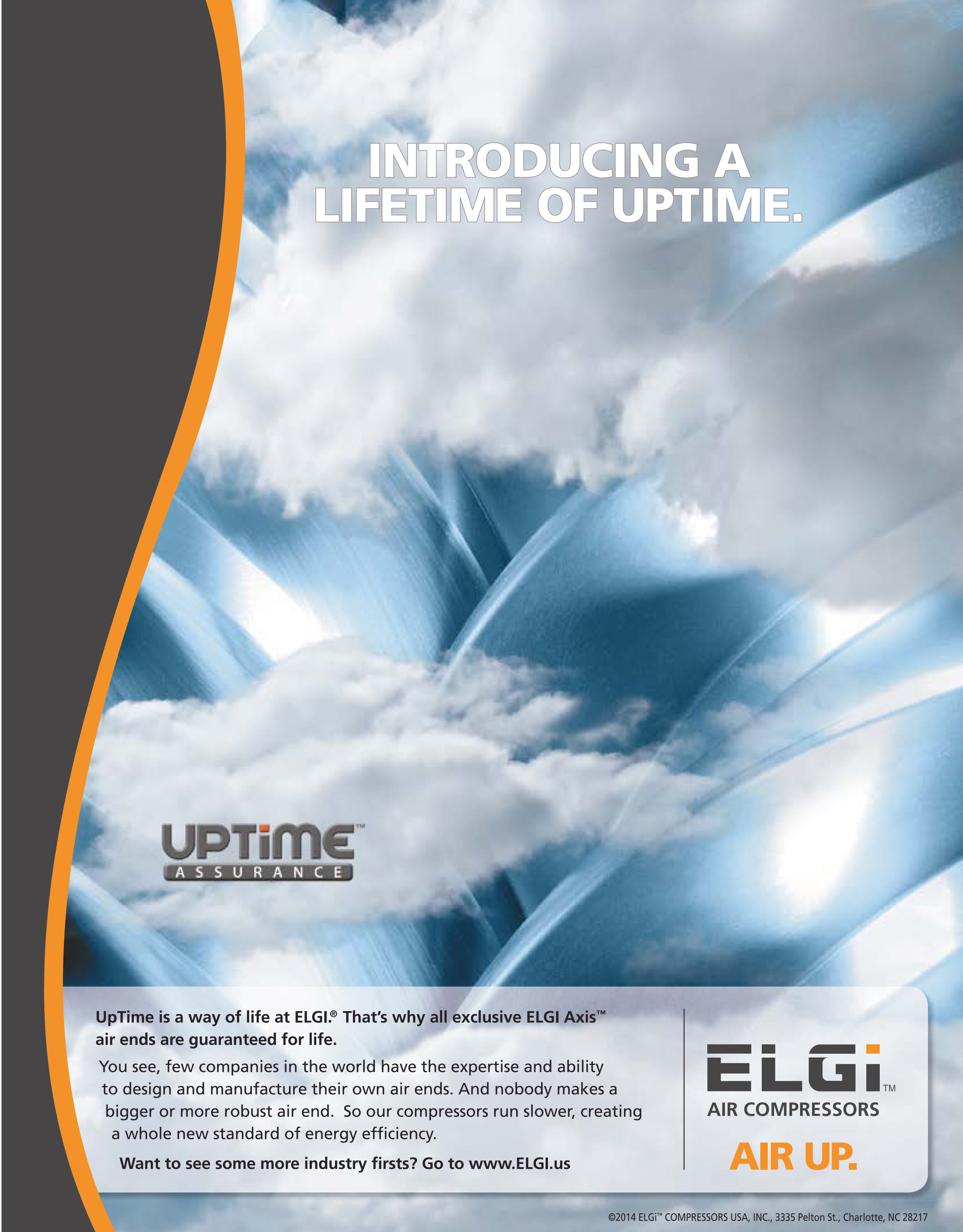


*Magazine Cover Image Provided Courtesy: Nissan North America.
Pictured is an inside look at Nissan North America's assembly plant in Canton, Mississippi.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FROM THE EDITOR | Metal Fabrication and Machining

Nissan North America operates out of ten significant manufacturing locations. Due to their large-scale operations, energy management projects can have significant financial and environmental impacts. The Nissan Powertrain Assembly plant, for example, on their 964-acre campus in Decherd, Tennessee encompasses 1.1 million square feet. Our own Clinton Shaffer had the opportunity to speak with Nissan's Mike Clemmer on their energy management strategy as it pertains to compressed air systems.

Eric Lee is a senior engineer at EnSave Inc., an energy auditing company. He shares audit stories with us on recently performed compressed air audits at two facilities of a leading U.S. steel manufacturer. Both plants are mills that melt, cast, and roll steel to produce a variety of products, including: rebar, merchant bar, steel flats, rounds, fence posts, channel bar, steel channels, steel angles, structural angles and structural channels.

A major Midwestern aluminum plant was experiencing dwindling compressed air capacity, primarily due to air leaks. If those capacity issues went unresolved, the facility would have needed rental compressors to keep up with demand. Instead, they turned to flow metering to identify and fix the leaks. In this case study, Jack Sine writes about how demand-reduction projects helped the two centrifugal air compressors, backed-up by eight reciprocating compressors, meet plant air demand of 20,000 cfm at 85 psig.

Tim Stearns is a Senior Energy Consultant for Efficiency Smart®. He shares an interesting story about how a steel forging facility evaluated switching their steam hammer system to a compressed air system. Faced with a $660,000 deferred maintenance decision on the steam hammer system, they did a comparison of the energy and maintenance costs of a boiler-driven system versus a compressed air system.

Kirk Edwards, from EXAIR, contributes an article on ways metal fabricators can reduce compressed air demand. He writes, "... it is difficult to name processes in metal fabrication where compressed air cannot be found. A few processes where compressed air is used include: annealing and pickling, slitting, rolling, welding, stamping, punching, tube making, painting, finishing, turning, drilling, milling and sawing."

Thank you for investing your time and efforts into ***Compressed Air Best Practices®***.

ROD SMITH
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INDUSTRY NEWS

BOGE America Appoints New VP and General Manager

BOGE recently announced the appointment of Nitin Shanbhag as Vice President and General Manager of BOGE America, Inc.

Gavin Monn, Chief Executive Officer of BOGE America, said: "The management of BOGE is pleased to have Nitin Shanbhag on board and see his appointment as key to the continued growth of BOGE in the Americas."

Nitin Shanbhag, newly appointed Vice President and General Manager of BOGE America, Inc.

Shanbhag is a graduate engineer with over 18 years experience in the American air compressor industry. His background includes an instrumental role in setting up the compressor division for Hitachi America and diverse sales, system engineering and product management roles at Ingersoll Rand.

For more information, visit www.BOGE.com/us.

ENMET Celebrates Two Exciting Milestones

ENMET is proudly celebrating 45 years of creative gas detection solutions. Environmental Metrology Corporation (abbreviated to ENMET) was founded in 1970 by Dr. Verne Brown. The company originally produced gas detection equipment for vehicular applications and then expanded into new markets, manufacturing portable gas detectors for industrial applications.

INDUSTRY NEWS

By 1977, ENMET began producing single- and multi-channel gas detection systems for industrial facilities and wastewater treatment plants, plus carbon monoxide monitors and air filtration systems for supplied-air respirators. Over the years, ENMET has earned a reputation for working closely with customers to design customized gas detection systems for their specific requirements.

Founder and former president, Dr. Brown, became an expert in the field of confined space safety and gas detection technology, travelling extensively, lecturing and conducting training seminars. Dr. Brown passed away on September 13, 2013 after a long battle with cancer.

ENMET Headquarters, Ann Arbor, MI

On July 10, 2014, ENMET Corporation was acquired by Chicago-based private equity firm Benford Capital Partners, LLC and became ENMET, LLC. It has been an exciting year at ENMET as we celebrate our one-year anniversary under new ownership. With the leadership of Norman Davis, President, ENMET is dedicated to building on our strong foundation, expanding our product line, and continuing to provide creative solutions for our customers.

ENMET continues to offer a wide range of continuous multi-channel fixed systems, respiratory air monitors, and portable detectors for a variety of hazardous gas conditions. We also design custom-engineered detection systems using our ISO 9001/AS9100C quality system for clients with unique applications.

For more information, visit www.enmet.com.

> "We are excited to be continuing to expand our global horizons with the opening of a new division in Yokohama, Japan. With a confident and experienced team, the division is well positioned to service and grow our client base in Asia-Pacific."
>
> — Lianne Walker MBE, Group Managing Director, Walker Filtration

Walker Filtration Expands to Japan

As part of a targeted global expansion strategy and following rapid yet sustainable growth, Walker Filtration has launched a new division in Yokohama, Japan.

With the company head office in Washington, UK, and having previously established successful divisions in Australia and the United States, Walker Filtration is delighted to announce further expansion.

Dr. Simon Bartram, Business Unit Lead for Walker Filtration's new Japanese Office

INDUSTRY NEWS

"Newport is a great location for our newest CNG station, as it provides a convenient refuelling location for long-haul trucks travelling through Greenville, Spartanburg and Asheville and will encourage more CNG adoption in Tennessee and North Carolina."

— Donna Rolf, President of ampCNG

Dr. Simon Bartram has worked with Walker Filtration for a total of five years and will be heading up the Japanese office as Business Unit Leader. His knowledge of the compressed air industry and specifically product development makes him ideally placed to lead the division to success.

"We are excited to be continuing to expand our global horizons with the opening of a new division in Yokohama, Japan," said Lianne Walker MBE, Group Managing Director. "With a confident and experienced team, the division is well positioned to service and grow our client base in Asia-Pacific."

Founded in 1983 by husband and wife Brian and Carol Walker, Walker Filtration is a family-run business that has continued to enjoy success on an international scale for over 30 years.

Walker Filtration exports close to 90 percent of its output to more than 60 different countries.

For more information, visit www.walkerfiltration.com.

amp Trillium Opens New Compressed Natural Gas Station in Tennessee

amp Trillium, LLC, the joint venture between ampCNG and Trillium CNG, recently opened a public-access compressed natural gas station in Newport, TN. Strategically located at Time Out Travel Center at 1130 W. Highway 2570, the new station is a convenient place for CNG-powered trucks and cars to refuel as they travel through western North Carolina and eastern Tennessee.

The Newport station services all CNG vehicles 24 hours a day, seven days a week and can fuel multiple Class-8 trucks simultaneously thanks to Trillium CNG's proprietary fast-fill hydraulic intensifier compressors. The station's close proximity to I-40 makes it an ideal location for amp Trillium's anchor customer.

Donna Rolf, President of ampCNG, said: "Newport is a great location for our newest CNG station, as it provides a convenient refuelling location for long-haul trucks travelling through Greenville, Spartanburg and Asheville and will encourage more CNG adoption in Tennessee and North Carolina. We're pleased that it only took a few short months to open this station and are proud to continue making CNG more easily accessible nationwide."

Joel Jansen, Vice President of Trillium CNG, said: "We are proud to make CNG available to heavy-duty fleets travelling the Newport, Tennessee corridor. An American fuel, CNG offers a variety of tangible benefits over diesel and gasoline, including lower fuel costs, long-term price stability and reduced greenhouse gas emissions. Fleet operators know that we stake our reputation on delivering a great fuelling experience for our customers — fast, safe and reliable."

Jonathan Overly, Executive Director of the East Tennessee Clean Fuels Coalition, added: "This site is a great addition to the growing number of public CNG stations in Tennessee and opens up the I-40 corridor to CNG traffic of all sizes. We enjoy working with our member ampCNG and will continue talking to Tennessee fleets to see how this site can help them make the transition to using cleaner burning, American CNG."

Long-haul truckers travelling along the North Carolina-Tennessee border have a new public-access CNG refuelling station.

amp Trillium now operates 22 CNG stations across the country, including one in nearby Charlotte, NC, and will continue to open several more in its mission to create a wide-reaching network of CNG refuelling stations along trucking corridors throughout the United States.

For more information, visit www.ampcng.com and www.TrilliumCNG.com.

Isel Expands into Ohio

Industrial lubricant manufacturer Isel Inc. has expanded into Ohio with a new manufacturing and distribution facility. The company guarantees faster distribution and easier access to their diverse line of lubricants.

Isel's new facility serves as the company's Midwest hub and will provide local distribution

INDUSTRY NEWS

Shipping times for Isel, Inc.

to customers in the Northeast and Midwest United States.

Combined with the company's headquarters in Florida, Isel can now ship its lubricants to a majority of the Eastern U.S. with one-day transit times. Isel customers will be able to significantly reduce their lubricant inventory and still retain reliable lubricant supply even for emergency orders. Isel does not upcharge for rush or emergency orders.

Isel's industrial lubricants are formulated, blended and packaged at both facilities via a high precision Micro-Batch™ manufacturing process. This allows for faster turnaround times — Isel aims for same day production on most orders — improved logistical support, and decreased operating costs for customers while maintaining high standards of quality.

"We pride ourselves on speed and service," said Isel Chief Executive Officer, Adam Sandler. "As the world's most agile lubricant company, Isel is world-class in servicing our customers in the way that they deserve."

For more information, visit www.iselinc.com.

Atlas Copco Rental North Acquires Mustang Services

Atlas Copco Rental, a leading provider of sustainable productivity solutions, has acquired the operating assets of Mustang Services, a specialty dryer rental business that primarily serves the rental industry to supplement their existing fleets.

Mustang Services rents out its equipment, mainly adsorption type air dryers, after coolers and filters, to the rental industry which services

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> **— Adam Sandler, Chief Executive Officer, Isel**

industrial, pipeline and other end-users that require dry compressed air in their processes. The products are often rented together with air compressors to provide customers with a total rental solution.

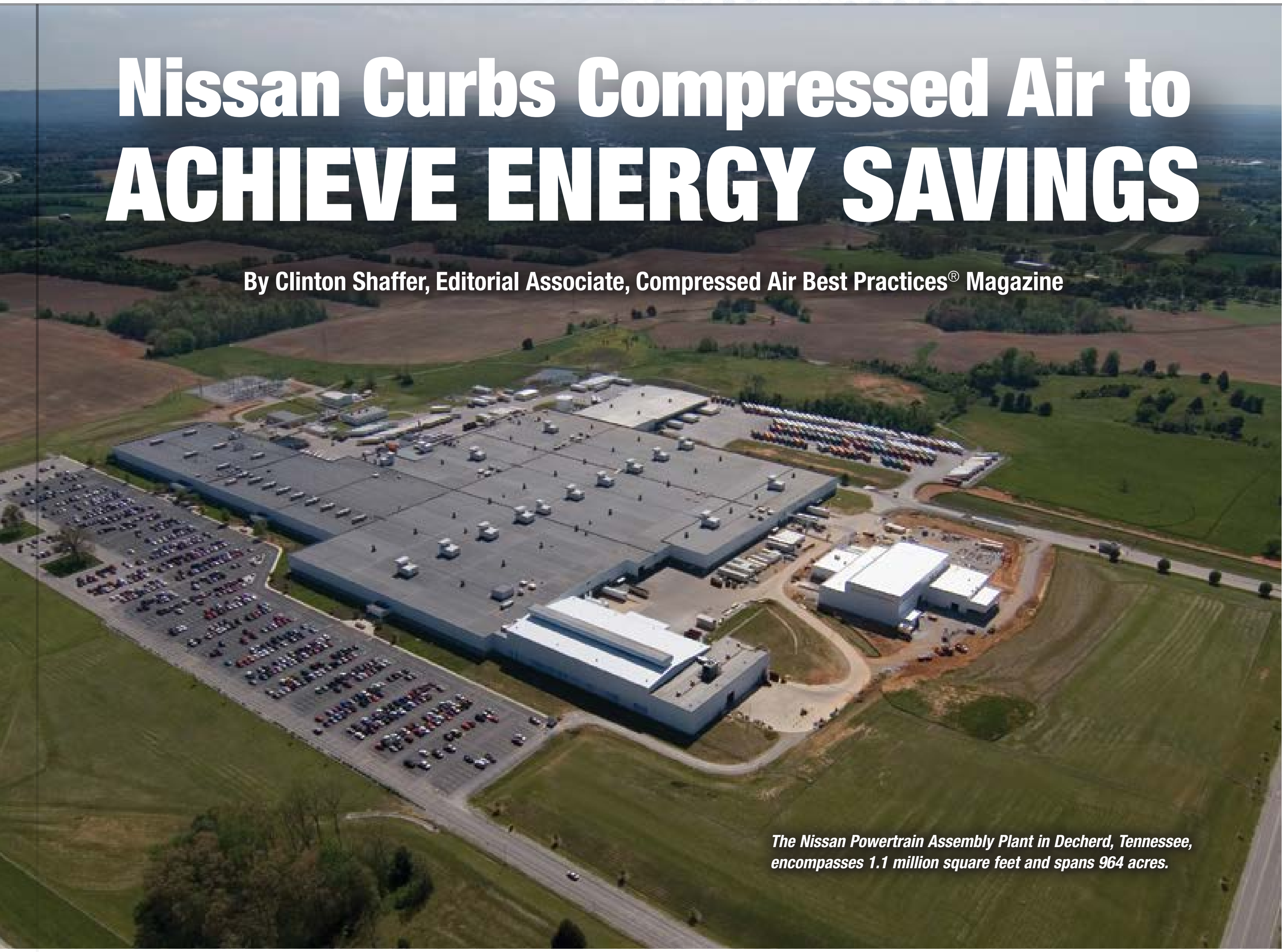
Dan Dorran is assuming the position of Vice President of Operations for Mustang Services. Dan has an extensive and long career in the compressed air and accessories rental business.

"I am looking forward to embracing this challenge and continuing the development of Mustang Service's business further," stated Dan Dorran, Vice President of Operations, Mustang Services. "Mustang Services has created a successful business strategy to supply high quality air dryer and treatment equipment to the market and the ability to build on this proven platform is exciting. As part of the Atlas Copco Specialty Rental Group, Mustang Services will benefit tremendously from the already established structure and logistics across North America."

For more information, visit www.atlascopco.com/rentalusus/.

Nissan Curbs Compressed Air to ACHIEVE ENERGY SAVINGS

By Clinton Shaffer, Editorial Associate, Compressed Air Best Practices® Magazine



The Nissan Powertrain Assembly Plant in Decherd, Tennessee, encompasses 1.1 million square feet and spans 964 acres.

Nissan North America operates on a massive scale. The company's powertrain assembly plant in Decherd, Tennessee, alone encompasses 1.1 million square feet, and manufactures engines for 14 different vehicles. The facility also handles crankshaft forgings, cylinder block castings, and other machining applications.

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Over the course of one year, the powertrain plant churns out approximately 1.4 million engines, an equal number of crankshaft forgings, and 456,000 cylinder block castings.

If you extrapolate that scale of operation to Nissan's ten other locations across North America, you can get a grasp of just how big the company's manufacturing presence really is. And, when you start talking about energy management, any one project can become a major undertaking involving a large number of people. Those projects also have a tremendous impact — both financially and environmentally.

Nissan's formal energy management program is called the Nissan Green Program, and it has helped Nissan earn recognition as an ENERGY STAR® Partner of the Year from the U.S. Environmental Protection Agency (EPA) every year since 2010.

Compressed air projects play a huge part in Nissan's energy management program — especially when you consider that compressed air accounts for more than one fifth of the powertrain plant's total energy spend. We had the opportunity to learn about the Nissan Green Program from one of the company's key professionals in energy management, Mike Clemmer, Director/Plant

Manager — Paint & Plastics at Nissan North America. Specifically, Clemmer discussed Nissan's energy management strategy as it pertains to compressed air, detailing specific optimization projects that led to substantial energy savings.

Nissan Green Program Overview

On October 24, 2011, Nissan announced its six-year environmental plan — the Nissan Green Program 2016. Under that program, the company aims to strike a balance between resource consumption and ecology, by both promoting and proliferating the use of green products, and adopting sustainable manufacturing practices.

"Nissan's commitment to the environment is evident through a number of initiatives, including the Nissan Green Program 2016," Clemmer explained. "It includes a goal to reduce the company's corporate carbon footprint by 20 percent from its 2010 baseline."

According to Clemmer, Nissan's energy team in the U.S. is an integral part of the program, and they work closely with the global management team to identify best practices for manufacturing processes. The energy program also leans on EPA's ENERGY STAR guidelines to help instruct members of its energy team.

"The energy team follows the EPA's ENERGY STAR Guidelines for Energy Management, using the ENERGY STAR Assessment Matrix to track how our energy management activities compare with industry best practices," Clemmer said. "We measure energy consumption per unit (vehicle/engine/part) and energy intensity to get down to the root of what we need for each process."

Compressed air is a vital part of the manufacturing operations at Nissan's vehicle assembly plant in Canton, Mississippi.

NISSAN CURBS COMPRESSED AIR TO ACHIEVE ENERGY SAVINGS

Nissan uses compressed air in a wide variety of applications, including spray finishing.

Nissan employs full-time personnel dedicated to identifying and repairing air leaks at each manufacturing facility.

Managing Compressed Air at Nissan

Compressed air is an integral part of Nissan's operations, and is used for a wide range of applications. Compressed air piping networks run throughout the company's manufacturing facilities, and the energy management team places a lot of emphasis on finding and repairing air leaks.

"Compressed air is essential to any manufacturing process, particularly in the automotive industry, and it accounts for about 23 percent of total energy costs at our powertrain facility," Clemmer explained. "With that in mind, we have two full-time workers in each of our manufacturing facilities — vehicle assembly plants in Smyrna, Tennessee, and Canton, Mississippi, and the powertrain plant in Decherd, Tennessee — dedicated to identifying and repairing air leaks. By regularly checking the meters, conducting leak checks and repairs, and performing audits, the energy team aims to achieve a compressed air leak rate of less than 10 percent of compressor output."

By vigilantly repairing compressed air leaks, Nissan aims to achieve a leak rate of less than 10 percent of compressor output.

Upgraded Solenoid Valves Eliminate Artificial Demand

In addition to identifying and neutralizing air leaks, the energy team at Nissan also works to reduce the amount of compressed air consumed in production. Clemmer described one great example, in which faulty solenoid valves were replaced to improve process integrity and energy efficiency.

"Our maintenance team at the Decherd powertrain plant recognized a series of solenoid valves that frequently failed, becoming permanent leaks," Clemmer said. "We set up a temporary flow meter and observed leak rates as high as 600 standard cubic feet per minute (scfm) for a production station. We worked with the plant maintenance team to upgrade the solenoid valve technology and reprogram the operation sequence to minimize compressed air consumption."

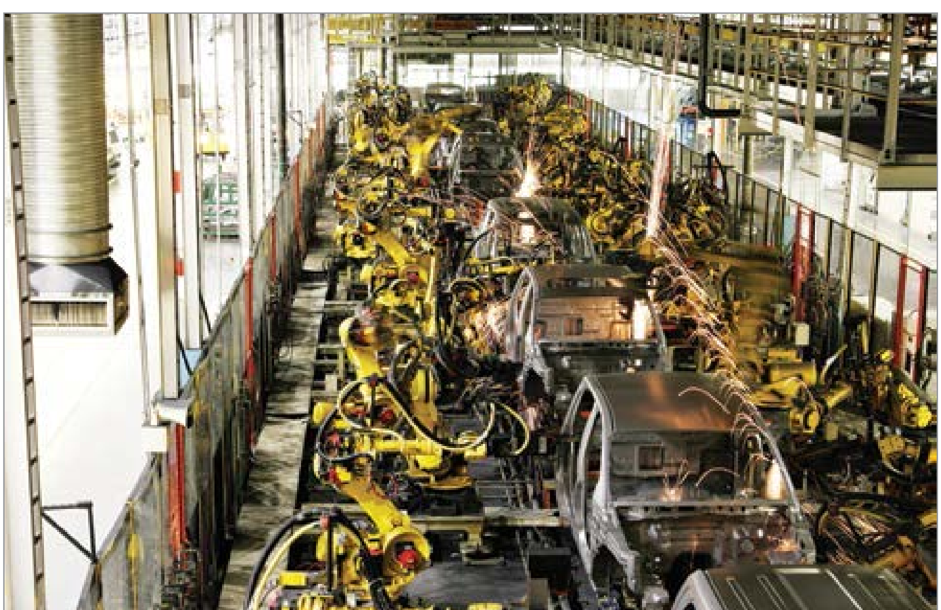
According to Clemmer, the end result was tremendous: The equipment stations now consume 75 percent less compressed air.

Optimizing Air Compressor Controls to Match Demand

Controlling air compressor performance is another focus area for the energy team at Nissan. In one of the projects that Clemmer described, engineers at Nissan centralized their compressed air monitoring system, giving them better insight into how the plant uses its compressed air supply.

NISSAN CURBS COMPRESSED AIR TO ACHIEVE ENERGY SAVINGS

Nissan's Vehicle Assembly Plant in Canton, Mississippi, produces 10 different vehicle models and spans 1,034 acres.



An inside look at Nissan North America's assembly plant in Canton, Mississippi

"We have simplified the monitoring process by tying the air compressors in several of our manufacturing facilities into a central computer that monitors the system pressure and handles the loading/unloading of the machines," Clemmer explained. "This has reduced the run-time of our machines to support our manufacturing operations, and it reduced motor starts, which led to improved stability of pressure in our plants."

In addition, Nissan's engineers are leveraging inlet guide vanes to better match plant demand with their centrifugal compressors.

"We are also optimizing the control sequence to further reduce unloaded compressed air though the bypass valve," Clemmer said. "Our manufacturing sites operate multiple centrifugal compressors, and they are equipped with inlet guide vanes. By operating multiple inlet guide vanes in sequence, we are able to throttle our compressed air supply to meet plant demand. We've managed to almost entirely eliminate bypassed air with this system."

Curbing Compressed Air Use

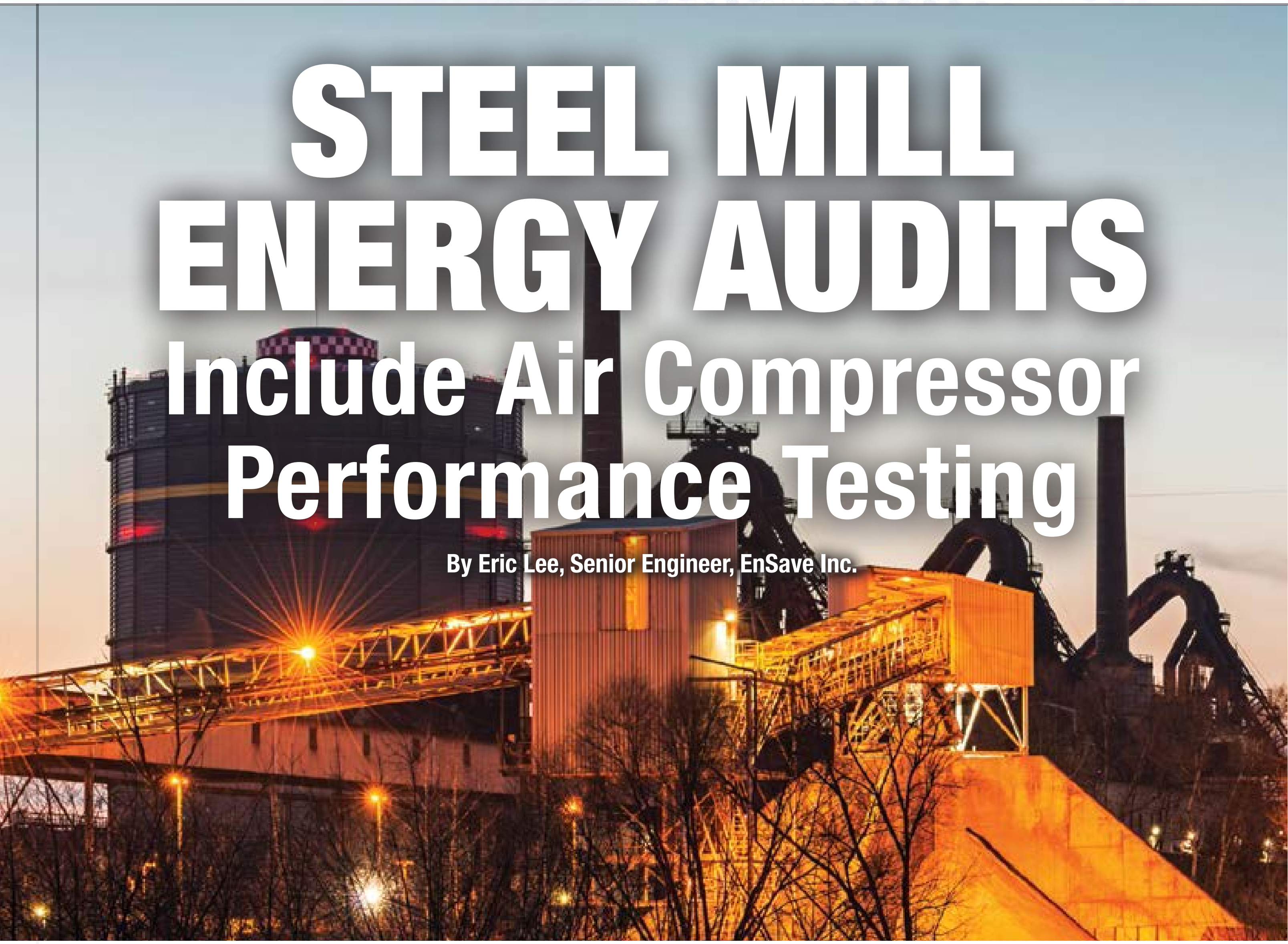
Compressed air is an essential resource for the manufacturing facilities of Nissan North America — to the extent that it is almost ubiquitous. The vehicle assembly plant in Canton, Mississippi, is capable of producing 450,000 vehicles in one year, and it employs more than 6,000 people. At that scale, there is a lot of potential for compressed air waste.

However, two of those employees are exclusively dedicated to diagnosing and repairing compressed air leaks throughout the facility's 4.2 million square feet. That is the kind of concerted effort needed to maintain energy savings through compressed air management.

Nissan North America's compressed air optimization projects are just a few of the many energy management initiatives that help Nissan to operate more sustainably. But, when their cumulative impact is measured across the massive scale of operations, even curbing the slightest amount of compressed air makes a major impact. BP

For more information about Nissan, visit www.nissannews.com. To learn more about ENERGY STAR, visit www.energystar.org.

For more articles about ***Energy Management,*** please visit www.airbestpractices.com/energy-manager.



STEEL MILL ENERGY AUDITS

Include Air Compressor Performance Testing

By Eric Lee, Senior Engineer, EnSave Inc.

EnSave, an energy auditing company based in Richmond, Vermont, recently performed compressed air audits at two facilities of a leading U.S. steel manufacturer. Both plants are mills that melt, cast, and roll steel to produce a variety of products, including: rebar, merchant bar, steel flats, rounds, fence posts, channel bar, steel channels, steel angles, structural angles and structural channels. These products are used in a diverse group of markets, including: construction, energy, transportation and agriculture. Compressed air is provided at 100 psig in both plants for a variety of applications — from optical sensor cooling to pneumatic cylinders for stacking finished products.

Plant A has a net annual capacity of 360,000 tons of steel products per year, while Plant B has a net annual capacity of 500,000 tons per year. EnSave worked with Plant A in the

> "All control strategies are set up with the best of intentions, but can stray over time due to a number of reasons. Instrumentation can drift, compressor performance can deteriorate, hardware can fail, and plant demands can change."
>
> — Eric Lee, Senior Engineer, EnSave Inc.

summer of 2013 as part of a utility energy efficiency program that provides cost-sharing for the audit report, as well as incentives for implementation. Following the study at Plant A, the steel company recognized the value of compressed air energy efficiency and contracted with EnSave to provide an energy audit at Plant B based on the merits of estimated savings. This speaks to the high value of a compressed air audit to deliver quick, cost-effective energy savings to industrial clients.

EnSave's systems approach assumes a "blank slate" that includes a review of both supply- and demand-side factors. This approach has allowed EnSave to find multiple compressed air opportunities that had previously been overlooked. Many plants assume that their compressed air system is operating as designed as long as there is sufficient flow and pressure to meet production demands. In reality, all control strategies are set up with the best of intentions, but can stray over time due to a number of reasons. Instrumentation can drift, compressor performance can deteriorate, hardware can fail, and plant demands can change from the original design.

One component of the audits that has proved to be particularly beneficial has been the performance testing of compressors through their full design range. This attention to compressor testing has yielded many unexpected opportunities for compressor replacement, control repair and modifications, and leak abatement program development. The focus of this article is to highlight some of these "surprises."

Issues with Compressor Capacity and Control

The compressors in Plant A have been in service for 4 years and are located in a central mechanical room, while the compressors in Plant B have been in service for over 15 years and are located in two mechanical rooms. Both plants operate 24-hour shifts with 14-day turnaround schedules.

There were three 500-hp rotary screw compressors in Plant A controlled in a master-slave configuration. One of the compressors acts as the master, and the remaining compressors are on a timed lead-lag sequence controlled by the master unit. All compressors were load/no-load compressors and were cycling every 10 to 20 seconds.

The compressors in Plant B were controlled from a master control panel with real-time compressor staging based on demand. The six screw compressors in use were staged with two base-loaded units and four trim units. The compressors were located in two compressor rooms, with five in one, and one in the other. While the master controller was designed to maximize the efficiency of the system, there were still multiple trim machines running that were part-loaded.

Capacitance Issues Drive Up Costs

In the case of Plant A, an initial review of the system components showed the equipment was mismatched in size. The three compressors were identically rated for 2187 cfm each for a total connected capacity of 6561 cfm, while the dryer was sized for 3816 cfm. The system was designed for two compressors to be operational with one in backup, and that was how the system was found. With just two compressors, the full flow is 4374 cfm. To confirm the capacity of the compressors, a pump-up test was conducted with a known fixed volume consisting of the piping and the wet-side receiver.

Based on the results of the pump-up test, it was determined that the compressors were operating at design capacity, and 15 percent over the rated dryer capacity at full flow. Since the compressors are fully loaded or unloaded,

STEEL MILL ENERGY AUDITS INCLUDE AIR COMPRESSOR PERFORMANCE TESTING

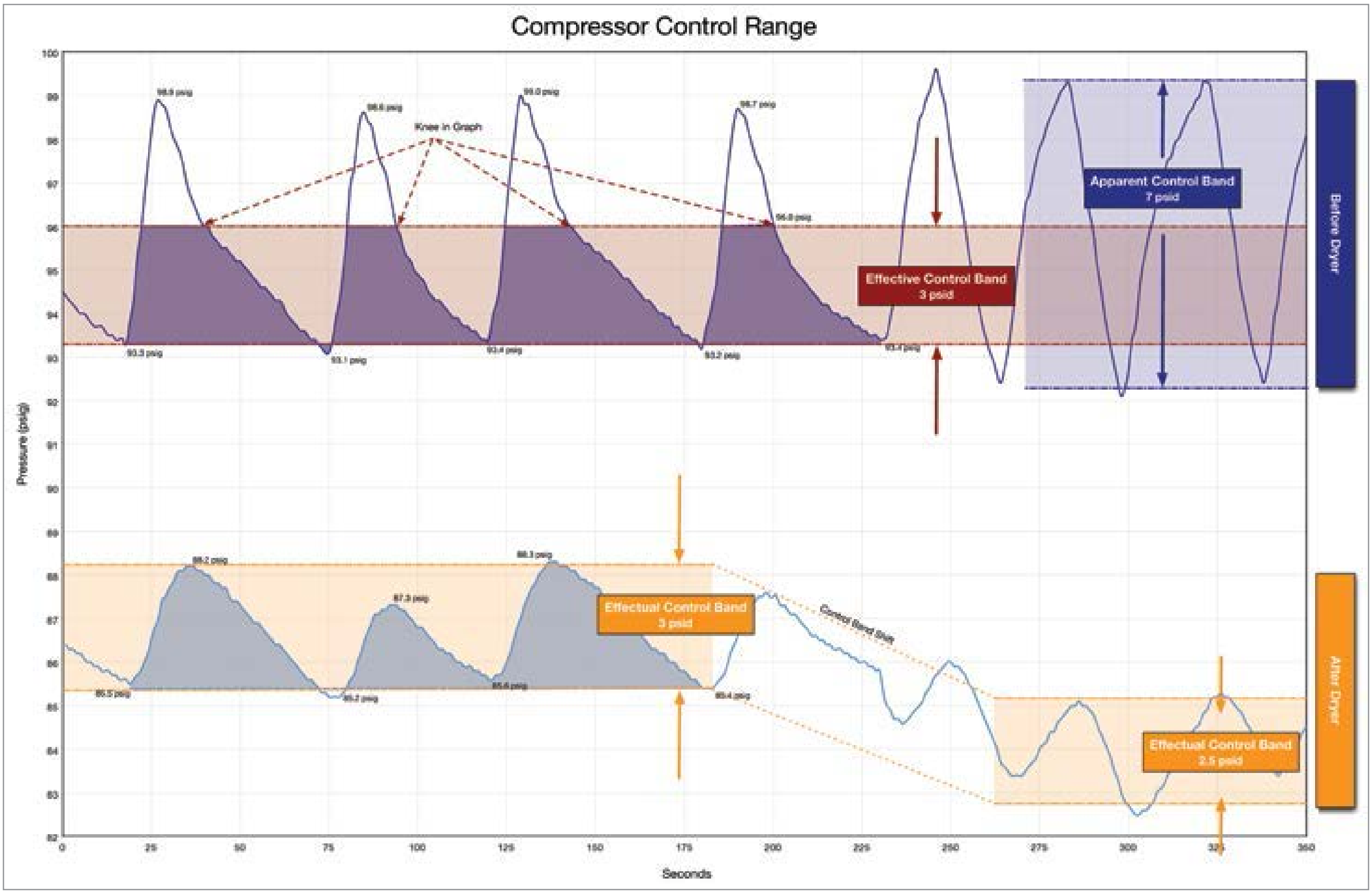


Figure 1: Impact of effective control band with compressor load cycles

it was determined that the short cycling of the compressors was directly correlated to the lack of system capacitance prior to the dryer, which reduced the actual effective control band (Figure 1) of the compressors.

Two options were considered for solving the problem: Increasing the capacitance of the wet-side receiver, or installing a variable frequency drive (VFD) compressor that could more closely respond to demand without overloading the dryer. The choice was made to install a VFD compressor, and the pump-up test results were utilized to more accurately recommend that the compressor be downsized to 350 hp. The annual savings achieved with this measure was 789,346 kWh.

Performance Testing Identifies System Inefficiencies

In the case of Plant B, the master controls were originally set up for real-time staging of the

"The choice was made to install a VFD compressor, and the pump-up test results were utilized to more accurately recommend that the compressor be downsized to 350 hp. The annual savings achieved with this measure was 789,346 kWh."

— Eric Lee, Senior Engineer, EnSave Inc.

compressors by matching the plant demand as defined by the compressors' rated performance and the rate of pressure decay of the system. As such, the sequencing of the compressors was predicated on the compressors operating as originally specified. With this in mind, flow-to-atmosphere tests were specified and conducted on all six compressors on-site to confirm both the full-load performance and the control response of the compressors.

The compressors were isolated, and flow-to-atmosphere tests were conducted with the use of an LP orifice flow meter, which measured the delivered cfm performance of the compressor to atmosphere. This data was then corrected to scfm at 14.5 psia, 68˚F and 0 percent relative humidity per CAGI definition.

Based on the full-flow results, it was seen that only two of the six compressors had a variance of less than +/- 10 percent of rated performance. In addition, it appeared that one compressor (CA4) was completely rebuilt with an airend that did not match the original specifications, and a motor was up-sized to accommodate it.

In addition to the difference in performance that was measured, the following mechanical repairs were noted for improvement:

1. The variable port controls on CA1, CA4 and CA5 were not unloading appropriately, as pressure continued to rise as demand was decreased during the tests.
2. CA2 unloaded but demonstrated a great amount of instability during testing, which brought into question inlet controls that might be impacting the compression ratio.
3. CA6 had variable port capability but was set to operate as an inlet modulating machine.

STEEL MILL ENERGY AUDITS INCLUDE AIR COMPRESSOR PERFORMANCE TESTING

TABLE 1: SUMMARY OF FULL-LOAD TEST RESULTS

COMPRESSOR	CA1	CA2	CA3	CA4	CA5	CA6
Rated Power (hp)	200	200	300	150	300	150
Actual Motor (hp)	200	200	350	200	350	150
Control Type	Variable Port	Variable Port	Variable Port	Variable Port	Variable Port	Variable Port
Rated Flow (acfm)	866	866	1300	650	1521	760
Rated Pressure (psig)	100	100	100	100	100	100
Test Pressure (psig)	105	98	90	111	96	102
Test Flow (scfm)	744	791	1025	721	1369	722
Corrected Flow (scfm @ 100 psig)	803	777	935.6	790	1241	735
Peak Test Power (kW)	179.9	155.2	230.1	142.1	260.2	129.9
Service Factor	1.21	1.04	1.03	1.27	1.16	1.16
Flow Variance	-7%	-10%	-28%	22%	-18%	-3%

These observations during testing led to recommendations that included repair of existing compressors, replacement of a poorly performing compressor, and the reprogramming of the master controls to better reflect the performance of the compressors. The savings opportunity with these measures was 992,727 kWh.

The Savings

The total savings associated with both projects totaled 2,977,259 kWh if all measures were included. For this article, only the savings associated with the measures identified with performance testing were listed. The combined savings totaled 1,782,073 kWh with a combined simple payback of 4.3 years without any utility incentives.

About EnSave Inc.

The principals of EnSave's industrial energy efficiency group have spent their careers working with customers to develop cost-effective energy efficiency strategies. Our engineering staff helps bridge the gap between management and maintenance personnel to deliver energy efficiency solutions that provide a clear, measurable outcome. At EnSave, we know that superior engineering expertise alone is not enough. Our clients need and deserve a partner who understands their business objectives.

EnSave

EnSave's industrial group has performed hundreds of industrial energy efficiency projects since 1988. Assessments of medium to large industrial sites have included food processing, primary metals, aerospace, automotive, petrochemical and others. We have broad experience in energy efficiency (including compressed air, pumping systems, refrigeration, motors, lighting), energy optimization, measurement and verification, basis of design, commissioning, retro-commissioning, project management, energy efficiency codes and standards, and sustainability planning.

EnSave also maintains an agricultural practice area focused on energy efficiency, environmental management, and sustainability planning for America's farms. EnSave is a leading designer and implementer of agricultural energy efficiency programs. BP

For more information, contact Eric Lee, tel: (208) 806-1815, email: ericl@ensave.com, or visit www.ensave.com.

To read more about ***System Assessments,*** please visit www.airbestpractices.com/system-assessments.

"Based on the full-flow results, it was seen that only two of the six compressors had a variance of less than +/- 10 percent of rated performance. In addition, it appeared that one compressor was completely rebuilt with an airend that did not match the original specifications."

— Eric Lee, Senior Engineer, EnSave Inc.

Aluminum Plant Meters Compressed Air Flow to SOLVE CAPACITY ISSUES

By Jack Sine

A major Midwestern aluminum plant was experiencing dwindling compressed air capacity, primarily due to air leaks. If those capacity issues went unresolved, the facility would have needed rental compressors to keep up with demand. Instead, they turned to flow metering to identify and fix the leaks. In this article, they share their solutions with others who may be having similar difficulties.

"We have a huge operation here smelting aluminum and making sheet aluminum for the food and beverage industry," said Mark, the utilities engineer. "A short while back we began to lose compressed air capacity. First I checked our air compressors. We have two centrifugal compressors that put out about 20,000 standard cubic feet per minute (scfm) backed up by eight reciprocating piston compressors that come on as demand increases. Compressed air system pressure is between 80 and 90 psi and our compressors run 24/7/365."

He continued: "I checked all of them, and all were working at their listed capacity. So we knew that air leaks must be responsible. We saw over time a gradual increase in demand. Different operations run at different times, so demand is never constant. We went into the winter, and demand kept increasing to the point that we were running everything we had. On days of high demand we were barely keeping up the pressure. If demand continued to increase, we would need to rent additional compressors, and they aren't cheap — about $100,000 a month plus fuel. As utilities engineer, I had responsibility for the compressors. So I needed to find out where the leaks were so we could repair them and restore capacity."

"At that time we had limited flow measurement capability, so I went online looking for a portable flow meter, one that I could take around the plant and check for flows that were higher than they should be, which would identify serious leaks. Most flow meters I found were intrusive — they had to be installed inside the pipe, so that left them out. I looked at some clamp-on ultrasonics, but they didn't seem robust enough for my needs. Then I finally found one that looked good on paper, so I gave them a call."

Mark called a representative of FLEXIM Americas, a manufacturer of flow meters for liquids, gases and process analytics.

"We got the call, and Mark asked if our portable meter would measure compressed air flow in the range of 80 to 90 psi," said Steve Davis, Midwest regional manager for FLEXIM Americas. "I told him that was at the low end of our scale for gas measurement, but that the meter would do the job."

How Ultrasonic Flow Metering Works

"The technique that FLEXIM's ultrasonic flow meters use is called transit-time difference," Davis explained. "It exploits the fact that the transmission speed of an ultrasonic signal depends on the flow velocity of the carrier medium, kind of like a swimmer swimming against the current. The signal moves slower against the flow than with it."

"When taking a measurement, the meter sends ultrasonic pulses through the medium, one in the flow direction and one against it," Davis continued. "The transducers alternate as

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emitters and receivers. The transit time of the signal going with the flow is shorter than the one going against. The meter measures transit-time difference and determines the average flow velocity of the medium. Since ultrasonic signals propagate in solids, the meter can be mounted directly on the pipe and measure flow non-invasively, eliminating any need to cut the pipe. And, since there are no moving parts, the need for calibration is virtually eliminated."

When first introduced, ultrasonic meters were met with skepticism, and there was one problem with them that justified that doubt. According to Davis, the couplant grease that sealed the transducer to the pipe would migrate out over a few years, and the meter would begin to give inaccurate readings. FLEXIM solved the problem by developing a non-grease solid pad couplant. Because of their success in the field, ultrasonic flow meters are now accepted as a highly accurate, non-intrusive measurement system.

Flow Metering Demonstration Removes Doubt

"We had Steve in to demo his meter," Mark said. "We were all pretty skeptical it would work. At first it looked like we were right. Steve had a few problems getting it to work at first. But it only took a little while, and he got the meter working. Everybody was impressed with both the accuracy and the ease of installation. I got the authorization to buy one immediately. I bought FLEXIM's G601 portable model designed for measuring gas flow."

"As soon as I got it, I started going around the plant measuring flow," he continued. "It was quite successful. We literally have miles of distribution piping. It even measured one-inch pipe, even though it's not supposed to. But you can trick it out to do it if you know how the meter works — the physics of it. I spent a year and a half slapping that thing on every pipe in this plant."

"Air leaks equal a tremendous amount of wasted money, and we spent all winter finding leaks and proving where they were to the engineers involved. The departments' personnel began the task of fixing leaks or replacing equipment. They were motivated by the potential expense involved if they ignored the problem."

Compressed Air Leaks in the Bag Houses

"We were able to identify the most significant leaks and pinpoint them — bag houses were some of the worst offenders," Mark said.

Bag houses are dust collection systems that suck air through a duct system, and the bags catch the dust. Periodically the bags clean themselves

The aluminum plant installed two ultrasonic flow meters — both on the main compressed air headers 60 feet above the floor.

> "Some bag houses that were calculated to have a legitimate demand of 750 scfm were using more than 3,000. And nobody knew it because until we got the portable ultrasonic, we couldn't measure flow."
>
> — Mark, Utilities Engineer

by pulsing compressed air through the bags. The dust goes into a hopper and is removed. There's a solenoid on each valve that opens up real quick, releases a puff of air, then shuts.

"We have a lot of bag houses, and a lot of those solenoid valves were stuck open," Mark explained. "We were able to calculate what a bag house should use, measure the flow with the meter, and some bag houses that were calculated to have a legitimate demand of 750 scfm were using more than 3,000. And nobody knew it because until we got the portable ultrasonic, we couldn't measure flow. We charge each area for its compressed air use, so now that usage was going to be accurately measured, everybody was onboard immediately to identify and repair air leaks."

Identifying Leaks in the Smelting Operation

"We also had leakage problem in our smelting operation," said Mark. "It's a constant, flowing procedure where we use large amounts of electricity break down alumina powder into aluminum and aluminum oxide. We need to keep a constant supply of alumina to the rectangular-shaped pots."

According to Mark, the problem with this type of smelting operation is that the aluminum oxide forms a hard crust on top of the smelted aluminum bath. Alumina has to be constantly fed into the pots in a finely tuned process.

The plant personnel overcome this difficulty by using two compressed air driven, chisel-headed cylinders on each of the pots. This

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equates to over 1,500 air cylinders. Every few minutes, a cylinder will punch a hole into the crust and, at the same time, it will open a vessel above it. Alumina powder will flow through the hole and into the bath. Unfortunately, after performing this action thousands of times, the cylinders begin to leak air. Manual inspection is iffy at best.

"We only knew for sure which ones were leaking when performance began to drop. That meant costly down time," Mark said. "When they leak they have to be rebuilt or replaced."

"By going around the whole smelter and measuring the compressed air flow, we were able to identify the worst and plan their replacement during planned downtime. Once we got going with this and the smelter engineers saw the data the meter provided, they realized how much time and money they could save. They wanted me to measure every pot line in the operation. I would measure a number of cylinders, download all the data I had gathered, and analyze it. We were then able to identify the most at-risk cylinders, and the smelter engineers were able to plan timely repairs or replacement."

"Between the smelter and packaging, we did the whole plant and identified all the areas where they were using too much air," Mark explained. "For that year, more than half of the day I was measuring air. The direct cost savings just for rental compressors and their fuel was estimated at $300,000. And that wasn't the only savings. Our cost to sustain one continuous standard cubic foot of air per minute for one year for us is in the 80-dollar range. We went from running 32,000 cubic feet at max points to about 22,000."

Flow Metering More Than Compressed Air

"We use high-temperature water as a heating medium for some of our processes. Our high-temperature, closed-loop water system delivers hot water at 350˚F," said Mark. "We use the heat from heat exchangers to heat buildings, process fluids, wash aluminum sheets, etc. We pay the power plant for the high-temp water, and we had an issue. We had no meter to measure what we were receiving. The only meter involved was an orifice meter at the power plant. They told us how much water we were using and how much to pay.

"But we had a history with them of lower temperatures than we wanted, and sometimes we felt the flows to our process areas were slower than we needed," Mark explained. "I proposed another FLEXIM meter for the hot water line. After our experience with the FLEXIM portable, I had no problem getting approval to purchase a permanent clamp-on FLEXIM liquid meter to measure the flow and temperatures to and from the plant. Now I've got sensors on the supply, on the return, and I've got temperature sensors on the pipe."

"Because of my previous knowledge of the air meter, I knew how the new one worked and had it installed and working in very short order. Both meters have data collection ability. The power plant was saying one thing, and we were saying another. Our flow data were showing lower by 500 gallons per minute or more than the power plant. Then we got into some other problems in the winter when the temperature of the water dropped and finishing lines were unable to maintain run speeds. I pulled the data from the meter and showed power plant engineers our flow and temperature data."

"We got together and started understanding each others' processes. They ended up checking their orifice plate computer and found it was calibrated wrong. Their guy looked at our figures and said, 'Well your numbers make sense because the maximum we can pump is 4,000 gallons per minute, and were showing 4,300 gallons right now.' Who knows how long its been out of calibration. After they made their calibration adjustments, our numbers got a lot closer together."

"As someone once said, you can't manage what you can't measure." BP

For more information, contact Jack Sine, tel: (845) 831-6578, email: jack.sine@verizon.net.

To read more about ***Flow Meters,*** please visit www.airbestpractices.com/technology/instrumentation.

"Our cost to sustain one continuous standard cubic foot of air per minute for one year for us is in the 80-dollar range. We went from running 32,000 cubic feet at max points to about 22,000."

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Steel Forging Facility MAXIMIZES INVESTMENT in Compressed Air System

By Tim Stearns, Senior Energy Consultant, Efficiency Smart®

When a company is considering making an investment of more than a million dollars in system upgrades, it is crucial for them to review all options to get the best return. By exploring energy efficiency impacts throughout the entire compressed air system, vendors can propose projects resulting in both a larger sale for them and increased financial benefits for their customers, while still meeting capital expenditure guidelines. This "best of both worlds" scenario was evident when a foundry in the Midwest was evaluating options for replacing its steam system used to drive the plant's forging hammers.

Steam hammers have proven to be invaluable in many industrial processes, especially the steel forging business. Yet steam systems are not energy efficient, as modern forging hammers are driven either hydraulically or with compressed air. This particular steel forging foundry knew it was time to contact its maintenance vendor for help when the company realized it was facing nearly $660,000 in deferred maintenance.

Analyzing the Existing System

The vendor and the foundry's plant engineer worked together to evaluate the existing system. It was determined the aging equipment would need to be replaced in the next 5 years. They were also able to calculate current annual operating costs. They calculated fuel, electric, water, and other miscellaneous costs using the approach described below:

Fuel Costs

- Assuming 1,101 British thermal units (BTUs) produce one pound of steam, and there are 1,000,000 BTUs in 1,000 cubic feet (MCF) of natural gas (at 100% efficiency), 66.1 MCFs produce 60,000 pounds of steam (the rated capacity of the boiler and the amount needed to drive the hammer system) each hour.

- At run hours of 3,000 per year, 66.1 MCF * 3,000 hours = 198,000 MCFs used per year.
- At $6.50/MCF (cost of fuel), the fuel cost is $430 per hour, or $1,288,950 per year.

Electric Costs

- The system water pumps are 300 horse power (hp) total. Converted to kilowatts (kW), 300 hp * 0.746 kW/hp = 223.8 kW.
- At $0.0854 per kilowatt-hour (kWh), the cost of electricity, operating 3,000 hours per year, (3,000 hr/year * 0.854 $/kWh * 223.8 kW), the electricity cost is $57,390 per year.

Water Costs

- Water usage is make-up water for the steam boiler. This amount (10,666 gallons per hour) was measured by the vendor.
- This amount is reduced by 10% (or multiplied by a factor of 0.9), assuming 10% of the water is returned back to the boiler as condensate.
- At $4.50/1,000 gallons (cost of water), 10,666 gallons/hour * 0.9 * $4.50/1,000 gallons * 3,000 hours = $129,600, the annual cost of water used by the system.

Miscellaneous Costs

- Annual boiler certification: $24,000
- Water treatment chemicals: $29,000
- Annual maintenance: $65,000

Switching from Steam to Compressed Air

The plant only needed steam production for 2,700 hours annually. However, the boilers ran an extra 300 hours each year during start up. A compressed air system driving the hammers would only need to run 2,700 hours. Therefore, the cost per hour of productivity of the existing system was $590. And, despite the plant having a variable load, the existing system was constantly producing the same volume of output, resulting in wasted energy.

Existing System Annual Operating Costs*	
Fuel Costs	$1,288,950
Electric Costs	$57,390
Water Costs	$129,587
Miscellaneous Costs *(Certification and maintenance costs)*	$118,000
Total Annual Boiler Operating Costs	$1,593,927

*Calculations based on a natural fuel cost of $6.50 per MCF, an electric rate of .0854 kWh, and a water rate of $.0045 per gallon.

Table 1: The foundry's existing boiler system has an annual operating cost of nearly $1,600,000.

Annual Operating Costs - Vendor Proposed System	
Compressor system electric costs *(2,700 hours per year, estimated CFM load profile)*	$723,000
Cooling tower electric costs	$19,200
Water costs (cooling tower)	$6,400
Maintenance costs	$65,000
Total Annual Operating Costs	$814,000

Table 2: The vendor-proposed system had an annual operating cost of $814,000.

STEEL FORGING FACILITY MAXIMIZES INVESTMENT IN COMPRESSED AIR SYSTEM

The vendor knew from experience that electrically driven compressed air systems typically produce around 100 cubic feet per minute (cfm) at approximately 20 kW, or 0.2 kW per cfm. Therefore, knowing that the plant required a maximum of 25,000 cfm, the operating cost of a new system would be no more than $427 per hour[1] — a savings of $163 per hour over the current system (or $440,000 annually). Based on operating costs alone, the natural solution was a switch to an electrically driven compressed air system to drive the hammers.

At this point, the plant engineer asked for a proposal for a new system.

Meeting the Customer's Financial Requirements

The foundry has capital expenditure guidelines that require any capital project have a simple pay back (SPB)[2] of five years or better. To meet this requirement, the compressed air vendor proposed a complete system with an installation cost of $3,910,000. The package included:

- Five 1,500-hp, water-cooled centrifugal compressors
- A 3,000 gallons per minute (GPM) cooling tower
- Heat of compression (HOC) desiccant air dyers
- All accompanying controls
- A 120-by-60-foot unheated building to house the equipment

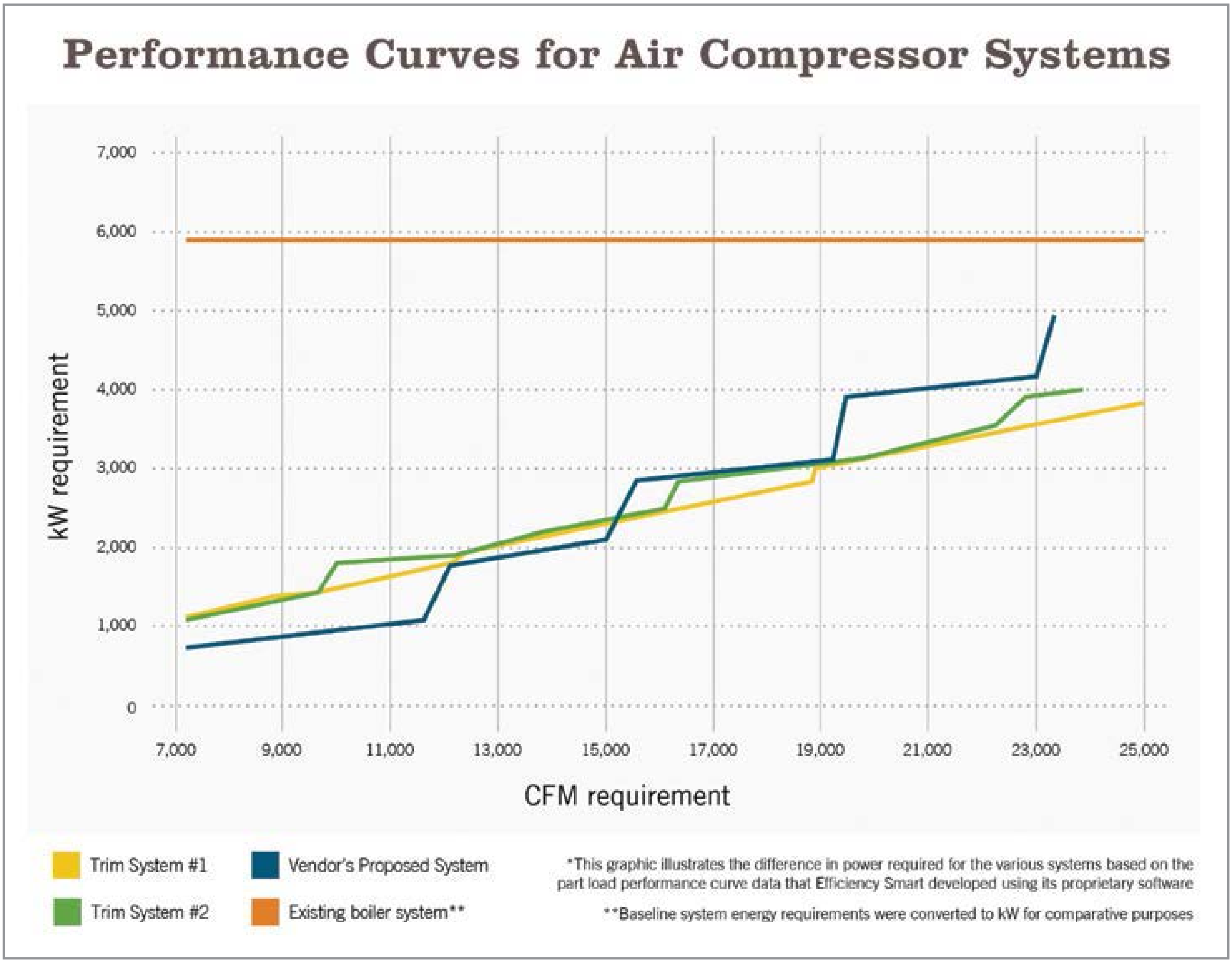

Table 3: Highlighting the result of the modeling and comparing power consumption at various loads in cfm.

Using the actual cubic feet per minute (acfm) load profile determined during the existing system assessment, the vendor was able to calculate the energy and water savings of the new system. In addition to the $660,000 savings in deferred maintenance, the vendor-proposed system (Table 2, pg. 33) would provide annual energy and water savings of $780,000 (nearly a 50 percent reduction from their current annual operating costs) and meet the SPB requirement of five years. The proposed system was estimated to result in an hourly operating cost of $302, assuming 2,700 operating hours per year.

Evaluating Different Compressed Air System Configurations

The foundry, like many businesses, wanted to reduce operating costs but realized that they lacked the in-house expertise to properly assess their facilities from both an asset management and an energy efficiency perspective. Seeking a third-party review of the vendor's calculated energy savings, the company contacted an energy efficiency consulting service provider for the foundry's electric utility.

An energy consultant from the energy efficiency service provider worked with the plant engineer and the vendor to confirm the energy saving calculations for the vendor-proposed system. While the vendor's proposed system met the foundry's initial financial requirements, the energy consultant asked a series of questions to determine if there was a better solution that would result in even greater energy savings.

The energy consultant used the information provided to design and model three compressed air systems with lower initial costs (Table 3). These systems included a series of smaller rotary screw compressors controlled to modulate based on cfm demand. The modeling confirmed that the vendor's proposed system was more energy efficient than any of the three systems with lower initial costs, eliminating these system options from further consideration.

However, the inherent inability of centrifugal compressors to match kilowatt (kW) input with cfm output also meant that the vendor's proposed system would still be operating inefficiently at some loads. Since the foundry's plant cfm requirement would be between 15,000 and 24,000 (i.e., 50 to 90 percent loaded) most of the time, the energy consultant modeled two more systems that incorporated high-efficiency rotary screw compressors acting as trim compressors into the vendor's proposed system.

At the higher system loads, the trim compressor systems are able to operate at

Compressed Air System Operating Costs		
System	**System Description**	**Average hourly cost**
Trim Compressor System - Option #1	(4) 1500 HP centrifugal with (2) 500 HP screw compressors—water cooled	$272
Trim Compressor System - Option #2	(4) 1500 HP centrifugal with (1) 500 HP screw compressor—water cooled	$274
Vendor's Proposed System	(5) 1500 HP centrifugal system—water cooled	$302
Low-Cost System - Option A	(13) 450 HP rotary screw compressors—water cooled	$335
Low-Cost System - Option B	(13) 450 HP rotary screw compressors—air cooled	$355
Low-Cost System - Option C	(22) 300 HP rotary screw compressors system—air cooled	$364
Existing Boiler System	Existing system using steam boilers	$590

Table 4: Comparing the compressed air systems

STEEL FORGING FACILITY MAXIMIZES INVESTMENT IN COMPRESSED AIR SYSTEM

AIR BEST PRACTICES™

> **"The energy consultant was able to identify energy saving opportunities when reviewing the existing system condensate drains. He observed that the system used timed drains, which were not the most energy-efficient option."**
>
> **— Tim Stearns, Senior Energy Consultant, Efficiency Smart®**

lower kW levels compared to the original system proposed by the vendor, and kW input more closely matches cfm output, resulting in a more energy efficient system with greater energy savings for the company.

By comparing the average hourly operating costs calculated for each system with the anticipated cfm operating requirement, a clearer picture was developed. The foundry's existing boiler system is the most expensive to operate, while the trim compressor systems are the cheapest to operate. The energy consultant recommended the Trim Compressor System — Option #1 from Table 4, as it is was shown to be not only the cheapest to operate, but the actual energy consumption will also vary proportionally with the load.

This option would create a system that would operate at a lower cost, as it increased the energy savings by $81,000 annually compared to the vendor's suggested system. It did, however, require an additional capital investment of $403,000, resulting in a SPB of 5.3 years, not meeting the requirements of the foundry's capital expenditure guidelines.

Searching for Additional Energy Saving Opportunities

The foundry's plant engineer wanted to move forward with the more energy efficient option (Trim Compressor System — Option #1), but needed to show a SPB of five years or less for the project to meet the company's capital expenditures guidelines. He challenged his energy efficiency service provider to help him meet this requirement, and so the energy consultant turned to the ancillary compressed air system equipment to look for additional opportunities for energy or cost savings. The energy consultant considered the typical energy conservation measures associated with compressed air systems, such as properly sized or additional air receivers, no-loss condensate drains, modulating speed controls on the cooling tower fans, energy efficient air dryers, system pressure reduction, and leak repairs.

After reviewing these typical measures, the energy consultant determined that all of the systems modeled included properly sized air receivers and that additional air storage would not increase energy savings. In addition, pressure reduction and leak repair energy conversation measures were not considered to be part of this project, but the foundry indicated that this could be a "Phase II Project" once the new compressed air system was up and running.

Since the equipment would be located in unheated space (the new building), HOC desiccant-style dryers were required. HOC dryers are the most energy efficient dryers available, since they need no additional energy to operate. However, the initial capital cost is higher than other dryer types. Adding heat to

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Efficiency Smart partners with public power communities to help their residential and business customers use less energy and save money. It provides a broad range of energy efficiency services to American Municipal Power, Inc. (AMP) member utilities through a performance-based contract, in which AMP communities voluntarily subscribe to its services.

AMP established Efficiency Smart for the benefit of its member communities, and the Vermont Energy Investment Corporation (VEIC) has held the contract for administering it since its services launched in January 2011.

the unheated building was not determined as a cost-effective solution. Therefore, no further energy or cost savings could be realized by switching dryers.

No-Loss Condensate Drains Improve Energy Efficiency

The energy consultant was able to identify energy saving opportunities when reviewing the existing system condensate drains. He observed that the system used timed drains, which were not the most energy-efficient option.

Drains are used to allow unwanted condensate to exit the system. Two basic categories of drains exist: timed drains and no-loss drains. Timed drains open a solenoid valve on a timed interval for a pre-determined duration. Since these drains are usually set for the longest period necessary, air is wasted when the valve opens for too long, as condensate is expelled along with some compressed air before the drain closes again.

A no-loss drain is controlled by a float valve and opens only when needed — not allowing any compressed air to escape and resulting in energy savings. The added cost for upgrading from timed drains to no-loss drains throughout the compressed air system and plant was calculated to be $4,800, but it would result in an additional $16,800 in annual savings. Therefore, the energy consultant proposed the inclusion of no-loss drains with this project.

Lastly, the consultant noted that the vendor's proposed system would use a cooling tower with two-speed fans. Speed control on the cooling tower fans allows the fans to slow as outside air temperature drops. When the air temperature is low enough, simply running water through the tower will create enough cooling that the use of fans is not needed. A variable speed drive (VSD) controller used to modulate the fan motor speed to just meet the cooling requirement would result in less fan motor energy consumption than two-speed fan control. The energy consultant recommended that the system include a VSD on the tower fans, resulting in an additional $6,000 in annual energy savings at an additional project cost of $11,000.

The additional energy savings associated with the no-loss drains and the VSD cooling tower fan control resulted in a project that was able to meet the foundry's 5-year SPB requirement at the lowest operating cost. The recommended trim compressor system with no-loss drains and cooling tower fan VSD control had a total project cost of $4,320,000, with an annual energy savings of $885,000 and a SPB of 4.9 years. The new project had increased annual savings by 13.5 percent, at an increased cost of only 10.5 percent.

Creating the Best of Both Worlds

Focusing on initial capital cost to ensure that the customer's financial criteria are met has been the traditional modus operandi for vendors. However, this is only one piece of the puzzle. Compressed air solutions that take into account operating costs as well as the initial capital cost can provide the customer with better financial choices, while potentially creating a larger sale. In this example of a Midwestern foundry, the project cost increased from $3.9 million to $4.3 million. However, it resulted in increased energy savings and still met the customer's financial requirements for the project, proving that you can have the "best of both worlds." BP

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Endnotes

1. 25,000 cfm * 0.2 kW/cfm = 5,000 kW, and 5,000 kW * 0.0854 $/kWh = $427/hour.
2. Project cost divided by project annual savings.

To read more about ***System Assessments,*** please visit www.airbestpractices.com/system-assessments.

"The new project had increased annual savings by 13.5 percent, at an increased cost of only 10.5 percent."

— Tim Stearns, Senior Energy Consultant, Efficiency Smart®

6 Steps Metal Fabricators Take to REDUCE COMPRESSED AIR DEMAND

By Kirk Edwards, EXAIR Corporation

➤ Compressed air use in the metal fabrication industry is widespread. It is used to cool, clean, convey and coat a multitude of products and improve processes across the world. In fact, it is difficult to name processes in metal fabrication where compressed air cannot be found. A few processes where compressed air is used include: annealing and pickling, slitting, rolling, welding, stamping, punching, tube making, painting, finishing, turning, drilling, milling and sawing. Many of these processes and applications continue to use inefficient devices to deliver the compressed air, and — worse yet — many companies fail to recognize the simple implementation and significant payoff of improving compressed air efficiency.

Improving compressed air efficiency, or saving more of your compressed air capacity by minimizing compressed air demand, can be realized by following some simple procedures. Though there are many actions that can be taken to further improve compressed air efficiency, some simple and effective steps can be put to action quickly. While all of these suggestions are relevant to anyone with a compressed air system, steps three and four provide examples specific to metal fabrication. Here are six steps to reduce demand in your compressed air system.

Step 1: Measure the air consumption to identify sources that waste compressed air.

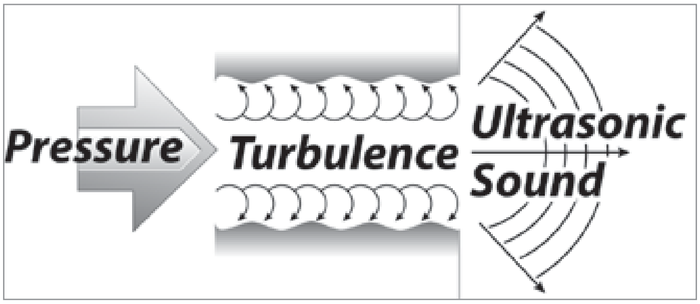
The first step is to have an appropriate flow meter, which can give an indication of how much air volume is being used. Flow meters can be installed on the main supply line of your system, and they will provide a good indication of overall use trends, while also being able to identify how much air is lost to leaks when the system is not being used for production. They can be installed on a smaller leg of the system that feeds a particular process or set of machines to indicate the demand from that section. Flow meters can also be installed at the machine level to track changes in flow due to maintenance, downtime or machine problems.

Another preferred feature of many flow meters is the ability to log the data. If calibrated correctly, data-logging flow meters can record data at many different intervals in order to provide a bigger picture of compressed air demand profiles. With the aid of a data-logging flow meter, any user can establish a baseline of air demand. Having this original compressed air demand baseline will be necessary in order to quantify and document any improvements in compressed air consumption and operating costs.

Step 2: Find and fix the leaks in your compressed air system.

Plants that are not maintained can waste up to 30 percent of the compressor output through leaks that go undetected. Compressing air is an expensive operation. Saving the compressed air wasted due to leaks reduces the overall operating costs and increases the effective capacity of your stored air. In large plants, the cost of a small air leak may be insignificant, but many small leaks — when located and repaired — can amount to huge energy savings. Reducing air lost to leaks can cause a rise in available pressure, which can provide additional energy to the point of use. With leaks fixed, the compressor will not have to operate as often to keep up with demand. Fixing leaks can minimize the required maintenance on the compressor as well.

Ultrasonic leak detectors (ULD) are a good choice for identifying leaks, because they are able to turn an inaudible ultrasonic sound signal into an audible tone that allows the operator to discover a leak.



Ultrasonic leak detectors turn inaudible signals into an audible tone.

Engineered compressed air products like these help save compressed air and money while improving safety.

Step 3: Upgrade your blow off, cooling and drying operations using engineered compressed air products.

Engineered compressed air products are made to replace ordinary nozzles, homemade devices and open line blow offs. An ordinary nozzle with a thru hole and a cross-drilled hole can be an easy choice based upon price, but if you do not consider the operating cost, you do not really know how much it is costing you. An engineered compressed air product will pay for itself and lower operating costs — many times, within weeks. Engineered nozzles provide a range of efficiency and safety benefits; most notably a reduction in compressed air use, meeting the OSHA standard for dead-end pressure, and reducing noise exposure for personnel. They can also qualify for an energy savings rebate from a local utility.

One common example is to use copper tube as a "nozzle" for blow-off applications. Found throughout metal fabrication facilities to eject parts, clean parts and cool parts, these nozzles should be primary targets for compressed air savings. A typical 1/4-inch OD copper tube will use as much as 33 scfm at 80 psig. The simplicity of installing a compression fitting on one end of the copper tube in order to accept an engineered nozzle makes this savings opportunity one of the simplest and fastest ways to begin reducing your compressed air demand.

Let's take a closer look at the savings you can achieve for a very typical scenario in the metal fabrication industry. Recently, a customer sent in their copper tubes for a test to compare with some engineered air nozzles. The pressure at the customer site was 80 psig inlet pressure for twenty 1/4-inch open copper tubes (22 scfm each), during an operation running 8 hours a day and 250 days per year. Depending on where you are located in the United States, your electrical costs will vary: The following example uses an estimate of $0.25/1000 cubic feet of compressed air.

6 STEPS METAL FABRICATORS TAKE TO REDUCE COMPRESSED AIR DEMAND

Engineered air nozzles are more efficient than open blow offs.

Open Copper Tube Cost of Operation:
20 pieces x 22 scfm = 440 scfm
440 scfm x 480 minutes per day = 211,200 cubic feet of compressed air required per day
211,200 x 250 days = 52,800,000 cubic feet required annually
52,800,000 / 1000 = 52,800 cubic feet
52,800 x $0.25 = $13,200.00 annual cost to operate twenty 1/4-inch open copper tubes

Engineered Air Nozzle Cost of Operation:
20 pieces x 10 scfm = 200 scfm
200 scfm x 480 minutes per day = 96,000 cubic feet per day (220,800 cubic feet saved per day)
96,000 x 250 days = 24,000,000 cubic feet annually (55,200,000 cubic feet saved annually)
24,000,000 / 1000 = 24,000 cubic feet
24,000 x $0.25 = $6,000.00 annual cost to operate twenty engineered air nozzles
$13,200.00 - $6,000.00 = $7,200.00 simple ROI in the first year, and payback time of 21 days!

Another repeat offender and candidate for an engineered upgrade in the metal fabrication industry is a standard section of pipe with holes drilled along its length. This is commonly done when needing to cover a wider area than an open tube or nozzle. We see this kind of solution when fabricators need to help separate metal sheets, blow liquid from parts coming out of a wash cycle, or remove machining chips as the part exits from a machining center. This next example is for two drilled pipes running at 60 psig inlet pressure, each with (25) 1/16-inch diameter holes on 1/2-inch centers, operating 8 hours per day and 250 days per year. We will again use the $0.25/1000 cubic feet of compressed air value for our calculations.

Drilled Pipe Cost of Operation:
2 pipes x 174 scfm = 348 scfm
348 scfm x 480 minutes per day = 167,040 cubic feet of compressed air required per day
167,040 x 250 days = 41,760,000 cubic feet required annually
41,760,000 / 1000 = 41,760
41,760 x $0.25 = $10,440.00 annual cost to operate two drilled pipes

Engineered Air Knife Cost of Operation:
Two 12-inch engineered air knives x 27.6 scfm = 55 scfm
55 scfm x 480 minutes per day = 26,400 cubic feet per day (140,640 cubic feet saved per day)
26,400 x 250 days = 6,600,000 cubic feet annually (35,160,000 cubic feet saved annually)
6,600,000 / 1000 = 6600
6600 x $0.25 = $1,650 annual cost to operate two 12" engineered air knives
$10,440.00 - $1,650.00 = $8,790.00 simple ROI in the first year and payback of 17 days!

Generally speaking, if it is a homemade solution being used, there is an opportunity for significant air savings.

Step 4: Turn off the compressed air when it is not in use.

A simple, manual ball valve and a responsible operator can provide air savings at every opportunity to close the valve and shut down the compressed air flow when it is not needed to a process or operation. But an automated solution is better for precise control, consistency and accuracy, which result in more compressed being air conserved. Automated solutions add solenoid valves that run independently with a sensor control, or can be run through machine controls. If the machine

"Another repeat offender and candidate for an engineered upgrade in the metal fabrication industry is a standard section of pipe with holes drilled along its length."

— Kirk Edwards, EXAIR Corporation

is off — or the process has stopped — close the solenoid valve and save your compressed air. Blow-off applications with space between parts can benefit by turning off the air during the part gaps.

Within the metal fabrication industry, we help customers who constantly blow air to remove stamped plugs when they could be letting more slugs build up before turning the air on. There are blow-off applications that are turned on with a machine or process but could be further optimized to eliminate blow off prior to a part reaching it. Also common are setups where air continues to blow during lunch or break time. For example, if a company kept its blow-off application running during its two daily 15-minute breaks and a 30-minute lunch, the company could save 15,000 minutes (250 hours) of blow-off cost every year! What's the lesson? Turn off your air when not needed.

Here is an example of a company who eliminated 5 minutes of blow off from its process using an automated solution consisting of a sensor, solenoid and timer to control the air:

$3,393 Annual Air Savings on a Tank Blow-Off Operation

A company that refurbishes large tanks runs the tanks through an oven on a conveyor line to burn off old paint. Only one tank at a time can be processed, and each takes 6 minutes to complete the journey. Four 30-inch air knives are used for blow off at the exit of the oven. These knives were using compressed air every time the oven was turned on.

However, the tank travels through the oven for 5 minutes before it reaches the knives for a 1-minute blow-off cycle. The opportunity for savings was to turn the air on only when the tank reached the air knives for a one-minute blow off. At 80 psig, the four knives consume 348 scfm.

The timer was set to "on/off delay." The sensor was mounted at the oven exit and opened a solenoid valve to provide 1 minute of blow off instead of blowing all 6 minutes of the cycle. This application ran 30 tanks per day on average.

Old Method
Four 30-inch air knives at 87 scfm each = 348 scfm
348 scfm x 6 minutes = 2088 scfm per tank
2088 x 30 tanks per day = 62,640 cubic feet per day
62,640 x 250 days = 15,660,000 cubic feet annually
15,600,000 / 1000 = 15,660
15,600 x $0.25 = $3,915 annual compressed air cost

New Method: Sensor/Solenoid/Timer Solution
The sensor and solenoid control was installed to shut off the compressed air for the 5 minutes where no tank was present (one minute of air on).
Four 30-inch air knives at 87 scfm each = 348 scfm
348 scfm x 1 minute = 348 scfm per tank (1740 scfm saved per tank)
348 x 30 tanks per day = 10,440 cubic feet per day (52,200 cubic feet saved per day)
10,440 x 250 days = 2,610,000 cubic feet annually (13,050,000 cubic feet saved annually)
2,610,000 / 1000 = 2610
2610 x $0.25 = $652.50 annual cost with optimized setup ($3,262.50 annual savings)
$3,915 - $652.50 = $3,262.50 simple ROI in the first year and payback of 146 days!

6 STEPS METAL FABRICATORS TAKE TO REDUCE COMPRESSED AIR DEMAND

Step 5: Use intermediate storage of compressed air near the point of use.

Also known as secondary receivers, intermediate air storage is especially effective when a system has shifting demands or large volume use in a specific area, generally in short bursts. The buffer created by intermediate storage (secondary receiver) prevents pressure fluctuations, which may impact other end-use operations and affect system reliability and product quality.

An application that is a good fit for a secondary receiver tank is one with a high intermittent demand of compressed air, short duration of this demand, and enough time in between demand events to replenish the receiver pressure without needing additional capacity from the compressor.

A properly outfitted intermediate storage tank includes a pressure relief valve to keep pressure to a value that does not exceed the tank limitation. A drain valve, typically mounted on the bottom of the receiver tank, releases condensate. A pressure gauge will allow you to view the tank pressure and ensure it is holding pressure. Pressure regulators will provide the proper pressure out of the tank and into the application.

Properly sized and located intermediate storage strategies can greatly improve compressed air system efficiencies by absorbing spikes from large compressed air events, allowing for slow and steady production of compressed air. Receiver tanks are easy to use and install, and require little maintenance.

Step 6: Control the operating air pressure at the point of use to minimize air consumption.

This is a very simple and easy process. All it requires is a pressure regulator. Installing a pressure regulator at all of your point-of-use applications will allow you to lower the pressure of these applications to the lowest pressure possible for success. Lowering the operating pressure of the application also lowers the air consumption. And it naturally follows that lower air consumption equals energy savings.

There are a wide variety of opportunities to reduce compressed air demand in the metal fabrication industry. All of the steps you can take, as described above, can be easily accomplished. Thousands of dollars can be saved by choosing to make a small investment in engineered products, which results in a return on investment of days or weeks. Additional benefits include meeting OSHA safety standards for dead-end pressure and noise exposure, which homemade and many commercial solutions do not meet. Finding the right vendor, with skilled expertise and a large selection of product to fit your needs, will help you to determine the best way to reduce your compressed air demand. BP

For more information, contact an Application Engineer at Techelp@exair.com, or visit www.exair.com.

To read more about the ***Metal Industry,*** please visit www.airbestpractices.com/industries/metals.

"Thousands of dollars can be saved by choosing to make a small investment in engineered products, which results in a return on investment of days or weeks."

— Kirk Edwards, EXAIR Corporation

RESOURCES FOR ENERGY ENGINEERS

TECHNOLOGY PICKS

Kaeser Unveils SAM 2 Master Control System

The new generation of compressed air system control is here with Kaeser Compressors' Sigma Air Manager 2 (SAM 2). SAM 2 brings the Internet of Things to industrial plants with its adaptive control, data storage, analysis, and predictive maintenance capabilities, and it does it all while ensuring a reliable, consistent supply of compressed air.

SAM 2 is a master control system for all compressed air production and treatment components. It optimizes pressure values, automatically adjusts system air delivery to accommodate fluctuating air demand, and optimizes system efficiency by constantly analyzing the relationship between control losses, switching losses, and pressure flexibility. Moreover, SAM 2 enables predictive maintenance with its built-in maintenance reminders and messaging capabilities. These features not only boost operational reliability and efficiency, but also significantly reduce energy costs.

Kaeser Compressors' Sigma Air Manager 2 (SAM 2)

With its user-friendly 12-inch color touch screen, SAM 2 shows at a glance whether the system is operating in the energy management "green zone," as well as operating status, pressure history, flow, power consumption, and error messages. Advanced networking capabilities mean data can be accessed anytime, anywhere.

For more information, visit www.us.kaeser.com.

SONOTEC Ultrasonic Leak Detectors Help Save Energy

Whether in large-scale industrial production, on assembly lines in medium-sized companies, or in small workshops, compressed air has an important role to play almost everywhere. And it accounts for a large proportion of energy needs. Regular checking of the compressed air system to identify leaks reduces operating costs appreciably.

There are no compressed air systems without leaks. Around 30 percent of the energy used in compressed air systems is lost through leakages. The leaks typically occur at couplings, valves or gates, as well as on faulty hoses, screw and flange connections, or corroded pipe work. If these leakages remain undetected, even the best compressed air control can be of no further help. The compressors have to compensate for permanent pressure loss in order to provide compressed air. They run for longer, need more energy, and wear out faster. The result is higher costs. The regular detection and rectification of leakages, which are often only millimeters in size, contributes to a huge cost saving and improvement in energy efficiency.

Maintenance with Ultrasound

Using SONAPHONE technology by SONOTEC, anybody can locate leakages and seal failures in compressed air, gas and vacuum systems quickly and easily. The ultrasonic devices detect sound waves, which are in a frequency range beyond that which human beings are capable of perceiving. The SONAPHONE renders the noises generated by

TECHNOLOGY PICKS

The acoustic horn for airborne probe L 50 for leak detection up to 8 meters.

escaping compressed air as optical values on the display and audible signals via a loudspeaker. In this area, the SONOTEC range includes the reasonably priced entry-level model, multifunction devices with a backlit display, data logger and USB interface, and, with the SONAPHONE E, an ultrasonic detection device for use in areas with high risk of explosion. The advantage of the ultrasound method lies in how simple it is to handle. The point that has been located is marked and then repaired.

Multifunctional Device for Multiple Applications

In addition to the fast, reliable location of compressed air and gas leaks, the handheld ultrasonic detection devices in the SONAPHONE range are also suitable for tightness testing of various systems, wear control on rotating machinery, and providing evidence of partial electrical discharges where there is insulation damage. The checking of steam traps and valves is another task covered by the mobile devices.

A multitude of optional attachments and probes enables a further extension of the SONAPHONE detection devices' areas of application. They can, for instance, be fitted with the Sonospot parabolic probe to allow measurements to be carried out at locations that are difficult to access. The light, user-friendly probe has a particularly high range and detects leaks and noises over distances up to 20 meters.

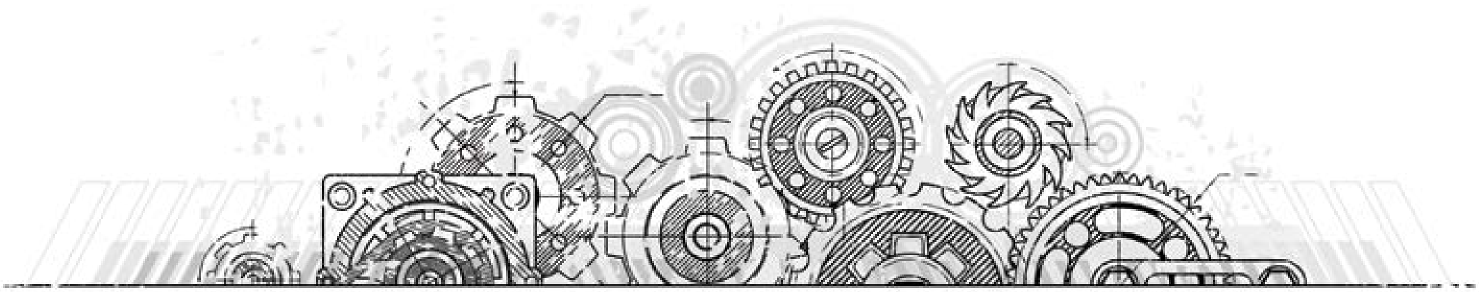
Compressed air losses always cost a pretty penny. Continuous leak detection and rectification make a significant contribution to energy saving. In addition, testing machinery using the SONAPHONE technology gives indications of where preventive maintenance work should be carried out to avoid greater damage and ensure machine availability.

For more information, visit www.sonotec.eu.

Metallized Carbon Corporation Announces Carbon-Graphite Piston Rings

Metallized Carbon Corporation, a global leader in the manufacture of oil-free, self-lubricating, carbon-graphite materials for severe service lubrication applications, recently announced the availability of carbon-graphite for use in piston rings needed to seal high-pressure gas in applications requiring compressed gases that do not contain oil or

Carbon-graphite piston rings are now available from Metallized Carbon Corporation.



RESOURCES FOR ENERGY ENGINEERS

TECHNOLOGY PICKS

grease. The piston rings are used in conjunction with carbon-graphite guide rings or carrier rings, which hold the piston centered on a cylinder bore.

Metcar's self-lubricating, carbon-graphite piston rings and guide rings are used extensively in reciprocating compressors, where oil-free gases, such as air, steam, refrigerants, hydrogen, hydrocarbons, chlorine, nitrogen and oxygen can be compressed to pressures greater than 800 pounds per square inch (psi).

Guide rings can be either solid rings or segmented rings with butt joints. Metcar's segmented, carbon-graphite, piston rings with overlapped joints are placed in a radial groove in the reciprocating piston with little clearance between the width of the groove and the width of the piston ring. At least two rings with offset segment joints are needed to seal to pressures of 100 psi. Extra sets of rings are needed to seal higher pressures.

"Metcar self-lubricating carbon graphite materials are particularly suited for this application because of their excellent lubricating qualities and good resistance to wear," said Matthew Brennan, Chief Operating Officer of Metcar. "Wear life up to 10,000 hours is possible when the compressor and piston rings are correctly designed."

For more information, visit www.metcar.com.

Siemens Sinamics Drive Now Features Integrated Web Server

Siemens recently announced the enhancement of its popular Sinamics® S120 drive system with an integrated web server to facilitate more efficient diagnostic and maintenance functionality for end-users, integrators and system designers.

With this drive improvement, a user may access the Sinamics S120 with any PC with a browser capable of Internet connectivity through

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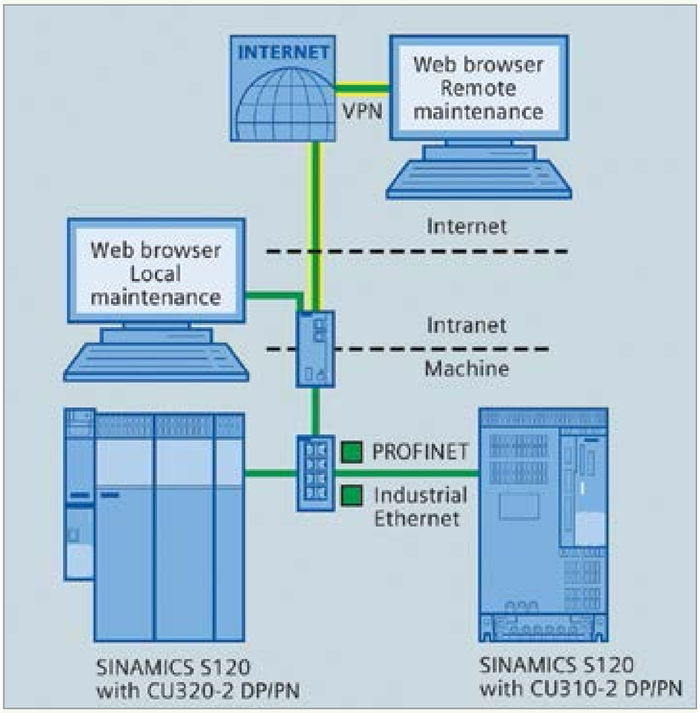

Users can access the Sinamics S120 with any PC with a browser capable of Internet connectivity.

a standard Ethernet interface to execute a variety of functions. If a wireless LAN (WLAN) router is networked, web pages can be viewed using other web-capable devices, such as tablets and smartphones.

Among the functions possible with this integrated web server on Sinamics S120 drive systems are the abilities to download a plant configuration, commission a drive from anywhere, perform firmware updates, access an immediate status overview on the drive, and check and assess all alarm and fault messages.

In addition, users can monitor and adapt all process or line parameter settings, archive machine documentation, including all notes taken, create customized server pages, set up user administration and access level for operator and service personnel, plus perform virtually all drive diagnostics and remote maintenance actions. This combination of service possibilities results in significant reductions in machine or line downtimes due to faster, more efficient diagnostic and maintenance procedures.

For more information, visit www.siemens.com.

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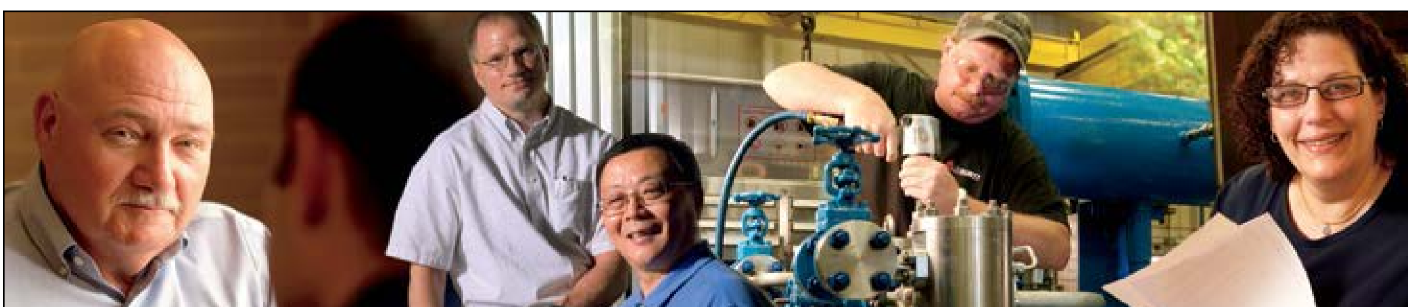

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— Henry Ford

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